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Technical Report 70

Vegetation of American Memorial Park Saipan, Mariana Islands

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Abstract

This inventory of the botanical resources at American Memorial Park comprised a general survey of the plants present, the preparation of a vegetation map, and the establishment of four permanent transects in the wetland. One hundred and twenty eight vascular plants including 13 ferns and fern allies were located. None are endangered nor are there any noxious species present. The vegetation types within the natural area include mangrove swamps, marshes, strand, coastal scrub and weedy scrub. Twelve plant communities are identified and mapped. Management recommendations include garbage control, controlling vehicle access to the shoreline and programs to introduce or enhance the growth of kamani (*Calophyllum inophyllum*), gago (*Casuarina equisetifolia*), and temple grass (*Zoysia matrella*).

Introduction

American Memorial Park (AMME) is a subunit of War in the Pacific National Historical Park located in Garapan on the island of Saipan, Northern Marianas (Fig.1). The park, established in 1978, commemorates Amercian soldiers who lost their lives in the campaign on Saipan during the Second World War.

The park is a small area, 133 acres (54 ha). It is a coastal area located just north of Garapan on a raised reef (Fig. 2). The focus of AMME is the modest memorial which is surrounded by a substantial recreational area. There is a small wetland within the Park's boundaries which has been manipulated over the years. Since the war, bulldozing and use of the area as a dump continued until 1978. The waste material was covered over and the area left untouched since then. A dense vegetation has taken over the area which is now the habitat of the endangered Marianas gallinule and a large number of other birds.

In 1982, the Northern Marianas government requested the U.S. Army Corps of Engineers to develop a flood control program for Garapan. Three of the options presented would directly affect the wetland area. The National Park Service became concerned about the impact of the preferred flood control option on the stability of the endangered gallinule habitat. They requested an inventory of the botanical resources of AMME with some detailed quantitative measurements of the vegetation within the wetland area.

Methods and Materials

General plant survey.

Plants were collected from all areas of the site during the initial survey of the wetland in 1986 and the subsequent survey in 1988 (Table 1). Voucher specimens were collected for each plant species and have been curated at the University of Guam Herbarium. Some duplicates are deposited at Bishop Museum, Honolulu, and the National Museum of Natural History (Smithsonian Institute), Washington, D.C.

Transect.

Quantitative measurements of the vegetation were collected using the line intercept method (Mueller-Dombois and Ellenberg 1974, Brower and Zar 1984: Table 2) along four transects (Fig. 3) in the wetland area

Vegetation Map.

The vegetation map (Fig. 4) was constructed from an aerial photograph of the area taken by the U.S. Geological Survey in 1987. The vegetation units were demarcated on the aerial photograph and ground proofed. The vegetation unit identification follows that of Jacobi (1989).

The Study Area

Saipan is the largest island, and also the capital, of the Commonwealth of the Northern Mariana Islands (CNMI). It is located at 15°12'N latitude and 145° 37'E longitude. It is approximately 13 miles (21 km) long and averages 4 miles (6 km) in width, occupying 46.6 square miles (12,070 ha). It lies within the humid

tropics, with an average annual temperature of 81.5°F (27.5°C) and an average relative humidity of 83%. The average wind velocity is 10.5 mph (17 kph); the NE and ENE trade winds are persistent during the January to May dry season whereas winds from various directions are less strong, and sporadic, during the rainy season (Tenorio and Associates 1979).

Saipan is a part of the Mariana Island arc system, and had its beginning about 42 million years ago in an area to the west called the Palau-Kyushu Ridge. Between that time and the present the island has undergone eastward movement, volcanic activity, uplift and subsidence with attendant reef formation, and erosion by wind, rain and movements of the sea. Contained within the rock formations are three volcanic cores, numerous fault lines, and layered volcanic and calcareous rocks (Cloud *et al* . 1956).

The west coast of Saipan south from the Magpi benches consists of an almost continuous lime sand beach backed by a few low limestone ridges and underlain by Tagpochau limestone formed in the early Miocene. The lowest bench and the entire western coastal plain are constructional in origin. The Matansa (Massacre) Fault which runs NNE by SSW and is downfaulted to the west (Cloud *et al.* 1956) passes along the eastern edge of the Park.

AMME is located on the northern boundary of the township of Garapan on the west coast of the island of Saipan (Fig.5). The park consists of the terrestrial environment only. Coastal waters and islets are not within the park's jurisdiction. It is bounded by Garapan and Tanapag Lagoons from approximately 100m south of Puntan Muchot to Puntan Flores on the north and west, Beach and Middle Roads on the east, and the road to the Hyatt Hotel on the south (Fig. 2). The area is part of a level elevated reef flat and all of it is less than three meters above sea-level. The whole area has been altered by bulldozing and the construction of roads and buildings. The wetland area, except that which lies between Beach Road and Tanapag Lagoon, is also modified so that there are two containment areas one of which is undrained, the other slightly to its south is associated with a small culvert under Beach Road. This area has been designated as a "natural area" by the park administration meaning that it will be managed to protect the natural resources in the area. The passerine birds and the endangered Marianas coot are significant natural resources of the natural area. An exercise track circles this entire segment of the wetland study site. The two ponding areas are separated by a dirt road raised about one and one half meters above the surrounding terrain. It is now impassable to vehicular traffic but bears along its southern margin a large diameter pipe, possibly an old sewage pipe.

The north-western edge of AMME abutting Tanapag Lagoon consists of artificial coral-fill jetties. The jetties are vegetated with a considerable amount of scrub on either side of the jeep road. The coastal margin of AMME along Tanapag Lagoon is a continuation of the interior mangrove swamp and coastal forest. It contains several dump-sites which are not only unsightly and unhygenic but also disrupt revegetation of the mangrove swamp (Figs. 6, 7, and 8).

Results and Discussion

There are 128 species of vascular plants in the Park (Table 1), thirteen (10%) of which are ferns and fern allies. The remainder are flowering plants; there are no conifers present. Fifty-six species (44%) are indigenous, none endemic to the Marianas. Seventy-two species (56%) are introduced, 67 (78%) of which are naturalized.

There are no federal endangered plant species present. There is no list of endangered plants for CNMI. None of the plants are rare by any consideration. However, the orchid *Zeuxine fritzii* (which was named for a German governor of Saipan) occurs at the swamp edge of the Park and has only been found in one other place in recent times, though perhaps is more common and merely overlooked.

None of the plants present is considered noxious by CNMI.

Importance values are derived from transect data (Table 2, Appendix 1) and relate to a species importance in numbers of specimens (the more numerous, the higher the importance), in frequency of occurrence (the more times a species occurs along a transect, the higher the importance), and in amount of cover (the greater the linear area the species occupies along a transect, the higher is its importance). In this survey, the numbers of

specimens often could not be counted, so that portion of the usual importance value was omitted. Importance values were calculated for each stratum (less than 1m, 1-less than 3m, 3-less than 10m, and greater than 10m), because understory species can be young of the top stratum species, which indicates successful replacement of dominants by themselves and therefore a climax vegetation. Understory species can also be young of the successional generation to follow, or they can be restricted by growth form and will always be small.

Data for Transect 1 indicate a weedy area in which dominance is shared by pago (*Hibiscus tiliaceus*), a native sprawling tree with great environmental tolerance, and tangantangan (*Leucaena leucocephala*), an introduced species common in disturbed habitats on limestone. *Nephrolepis hirsutula* is a terrestrial fern, and most other species are aggressive vines.

Transect 2 extends into an open wetland dominated by the swamp fern langayao (*Acrostichum aureum*); most other dominants are vines, and tangantangan and gago (*Casuarina equisetifolia*) are the only tree species of any importance.

Transect 3 occupies an area dominated by large strand species such as nonag (*Hernandia sonora*), pahong (*Pandanus dubius*) and binalo (*Thespesia populnea*) and ferns in the understory. Weed species are not very significant here, and the understory contains a variety of strand and limestone forest species, and few vines.

The dominant species at most levels of Transect 4 is the mangrove mangle lahi (*Bruguiera gymnorrhiza*), but the area along transect four also contains pahong, pago, gago, nonag, and more than 10 other species, only one of which is introduced.

The area of transects 3 and 4 contains native species which are part of a self-replacing, climax vegetation, while that of transects 1 and 2 is weedy and changing, except for the open-water habitats containing ferns. Pago is of importance to both areas.

Vegetation types within the natural area include mangrove swamps, marshes, strand, coastal scrub and weedy scrub.

Mangrove swamps are wetlands dominated by woody mangrove vegetation, in this case (Fig. 9). It is the dominant and only Pacific mangrove species in the park (and Saipan) although other species are common to mangrove swamps further south. Pago is always an edge species of almost every ecosystem in the Marianas though it is more abundant around wetland areas. Its abundance results from its ability to take root anywhere along the stem. Therefore, when the tree overextends and falls or when strong winds, such as typhoons, knock it down the tree is not killed, rather a number of new trunks are produced. In a wetland more moisture is available to support these new shoots. Langayao is a typical swamp fern. It tolerates a moderate amount of salinity and thus tends to be a feature of mangrove swamps in the Marianas and elsewhere. Gago, though present in the swamp, is typically confined to sandy areas above standing water.

A small marsh vegetated with saltgrass (*Paspalum distichum*) and edged by *Scirpus littoralis* and langayao (Figs. 10 and 11) lies at the southwest portion of the interior. Another grassy area along the north and northwest part of the interior is not a marsh, but does get appreciable moisture; the grasses are elephant grass (*Pennisetum purpureum*) and Guinea grass (*Panicum maximum*), which are large but are not wetland species.

Many of the other species, including nonag, banalo, banago (*Jasminum marianum*), pahong (*Pandanus dubius*)and the herbs *Hymenocallis littoralis*, alaihai (*Ipomoea micrantha*) and bayogo dikika (*Mucuna gigantea*) are typical strand species as well. The presence of these strand species in the swamp is simply the result of proximity to the shoreline and the sandy substrates which predominate within the study area because of bulldozing.

There are a number of weed species in the area which indicate that the area has been and is still disturbed. Tangantangan, a dominant woody weed and an important soil stabilizer, has declined significantly now that the psyllid, *Heteropsylla cubana*, has become established. All the vines, such as mile a minute (*Mikania scandens*), fofgu (*Ipomoea indica*) and ahgaga (*Momordica charantia*) (Figs. 12 and 13) tend to climb and provide a dense shade; now that there is dead tangantangan, this will provide a suitable support which will have to be accepted until other shading tree species invade the area.

The coastal scrub is a combination of species which are early colonists, and those which will be later climax vegetation. The jetties where this vegetation type occurs are dominated by brushy plants such as *Eupatorium odoratum* (Fig.14), *Pluchea indica*, *P. symphitifolia*, hunig (*Tournefortia argentea*), nanaso (*Scaevola sericea*), *Indigofera suffruticosa*, *Desmanthus virgatus*, banago and gasoso (*Colubrina asiatica*). There is also an impressive stand of *Dodonaea viscosa* in a place quite unusual for this species. However, it is extending itself and appears to be a successful colonizer although the storms may be detrimental to its continued survival in the area.

Several of the open areas are being taken over by temple grass (*Zoysia matrella*). This species stabilizes the sand yet it is tolerant of such an exposed salty habitat. It should be encouraged and planted in the picnic areas.

The weedy scrubland occurs on scraped limestone over which there is a veneer of "soil." It is dominated by a variety of grasses, the sedge nutgrass (*Fimbristylis cymosa*) and various herbs such as *Desmodium* spp., *Polygala paniculata*, and hunig tasi (*Heliotropum procumbens*). This area is a highly artificial man-induced environment.

The park has one of only three mangrove sites on Saipan; the other two are at Salt Spring, also called Starch Factory Spring/Sadog Tasi, and along the western edge of Hagoi Susupe (Lake Susupe) where the Japanese-built canal brought in sea water. Mangroves are important land holding systems that buffer the effects of storms from the sea and hold erosion products moving off the land. Thus, they actually increase the size of areas in which they are found. Secondly, they are important nurseries of the young of many marine fishes and provide a sheltered, nutrient rich environment for species such as edible crabs and birdlife in general. As with all wetlands man should encroach with great caution. Any further disturbance to the area is potentially disastrous.

Although the area has obviously been a dump and a dumping site and has had much modification by bulldozing, it nevertheless has a long history of being a wetland and is so indicated on old maps and early references. There are many large structural units within the area. Decisions regarding the removal of smaller structures and concrete foundations will have to be evaluated in the light of the damage that might occur to the system. There are some concrete bunkers that could be left *in situ*. There are some metal structures that are deteriorating rapidly.

The old roadway could be cleaned up slightly and made into a short nature trail. A short diversion aligned along the axis of transect 2 would provide a good example of typical wetland communities. At least four families of the yellow honeyeater and at least an equal number of the cardinal honeyeaters were seen. Other birds including the white-faced dove, rufous-fronted fantail, and bridled white-eyes use the area and were readily observable.

Transect 4 area has large mangle lahi, gago and langayao (Fig. 3, Table 1). On the ground there are orchid species and a variety of species which would be expected in a climax forest. The diversity of species in this area makes it a particularly valuable area.

Botanically, the park comprises areas of weedy shrubs, strand and mangrove species. The jetty areas have yet to develop into a mature climax ecosystem. They are still in a successional stage.

The mangrove swamp should not be allowed to dry out. If the proposed drainage canal results in loss of water from the system then mitigation must be planned to ensure that the swamp remains as swamp. The swamp is probably a balanced ecosystem of salt and fresh water. If the proposed canal is going to upset that balance then some mitigation must be planned. A prominent fault of the west coast of Saipan, the Matansas (Massacre) Fault occurs along the west coastal plain. Its exact location relative to the swamp and the proposed drainage canal should be ascertained because of the impact of the fault on drainage pattterns. It is important to understand that the canal will probably interrupt the sheet water flow that is an important source of fresh water in the swamp.

Recommendations

Garbage control

Stop the dumping of trash along the coastal margin of Tanapag Lagoon. This will allow the mangrove to serve as a buffer between the sea and the main road

preventing storm damage to the road and the rest of the park.

Negotiate the closure or proper management of the dump on Puntan Flores. Not only is the garbage which blows into the park unsightly and probably unhygenic, it also is an impediment to the establishment of many plants. The value of the recreational areas being developed on the jetties will also be impaired.

Introduce kamani to coastline

The park should consider the possiblity of planting palo maria (*Calophyllum inophyllum*, Mangosteen family) along the jetty area especially in areas where it is wide enough to make picnic areas. This tree will tolerate salt water and spray and is also a common strand inhabitant in most of the Pacific. It will provide good shade for the picnickers. The root system will stabilize the shoreline yet the trees are very resistant to high winds.

Expand temple grass sward

Temple glass (*Zoysia matrella*) should be transplanted from the areas it now occupies to other picnic areas. It is tolerant of trampling and will serve to stabilize the substratum. It is best transplanted by removing strips from healthy colonies and planting firmly in the desired area during the rainy season. The Park staff should do everything they can to discourage local residents from their current practice of removing segments of the turf for their own use (Fig. 18).

Encourage growth of gago

Encouraging the further establishment of gago (*Casuarina equisetifolia*) along the jetties will also help to stabilize the substratum, but more active intervention will be required to shore up the jetties which are now in a precarious state (Fig. 15).

Control vehicle access to shoreline

The development of roads on the ocean side of Beach Road should be discouraged. These roads can be a focus for storm activity which will be concentrated through these gaps and damage the road. Fishing and other activities in the area are acceptable as long as they do not result in opening the coastal forest.

Acknowledgments

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Table 1. Vascular Plants of American Memorial Park, Saipan

Legend:

Name

Information relates to classification of the plants. Capitalized words show categories as large as FAMILY, or larger. Family names typically end in -CEAE. Italicized words are the scientific names – the genera (genus names) first; species names second. Names/abbreviations after scientific names are the person(s) who named the species. Names below the scientific name are common names, including Chamorro local names.

Growth form

Growth form refers to the appearance of the plants.

H	=	herbaceous; plants with little or no woody growth.
S	=	shrubs; woody plants with several major trunks.
T	=	trees; woody plants with generally one major trunk.
V	=	vines; woody or non-woody plants which can not stand free by themselves.

Habit

Place in community.

T	=	terrestrial; rooted in relatively dry soil.
A	=	aquatic; rooted, floating or emergent in watery situations.
E	=	epiphytic; attached to the surface of another plant, and using that plant for support, only.
P	=	parasitic; unrooted but attached to another plant and utilizing its food as well as support.

Status

The relation of the plant to the site.

Nd	=	indigenous - native to the site; evolved there, or arrived by natural transport.
Nt	=	introduced - brought in, accidentally or deliberately, by man or his agents (planes, canoes, dogs, etc.).
Nt/N	=	introduced/naturalized - behaves as an indigenous species; prospers without the assistance of man.

Relative abundance

Comparative numbers in the communities where the species occur(s). /Cl = Clumped - a modifier used to indicate very uneven spacing species like grasses, etc. For example, a species may occur only one place in a site, but several plants will be close together (R/Cl).

R	=	Rare - less than 5 plants per 100 m^2 in sites where they occur.
U	=	Uncommon - more than 5 but less than 20 plants per 100 m^2 in sites where they occur.
C	=	Common - more than 20 but less than 50 plants per 100 m^2 in sites where they occur.
A	=	Abundant - more than 50 plants per 100 m^2.

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Ferns and Fern Allies				
Ophioglossaceae (Adder tongue fern family)				
Ophioglossum nudicaule L.f.	H	T	Nd	R
Polypodiaceae (Polypod family)				
Acrostichum aureum L. Langayao; Giant swamp fern	H	A	Nd	U/Cl
Antrophyum plantagineum (Cav.) Kaulf.	H	E	Nd	R/Cl
Davallia solida (Forst. f.) Sw. Pugua machena	H	T,E	Nd	U
Nephrolepis hirsutula (Forst.) Presl.	H.	T,E	Nd	C
Polypodium punctatum (L.) Sw. Bird's nest fern	H	E	Nd	U
Polypodium scolopendria Burm.f.	H	T,E	Nd	C
Pteris vittata L.	H	T	Nt/N	U
Pyrrosia lanceolata (L.) Farw.	H	E	Nd	C
Tectaria crenata Cav.	H	T	Nd	U
Thelypteris opulenta (Kaulf.) Fosb.	H	T	Nd	R
Vittaria incurvata Cav. Shoestring fern	H	E	Nd	R/Cl
Psilotaceae (Psilotum family)				
Psilotum nudum (L.) Grisebach Whisk fern	H	T,E	Nd	R

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Monocotyledons				
Araceae (Arum family)				
Alocasia macrorrhiza (L.)Schott	H	T/A	Nt	R/U
Arecaceae (Palmae) (Palm family)				
Cocos nucifera L. Niyog; Coconut	T	T	Nt/N	U
Cyperaceae (Sedge family)				
Cyperus brevifolius (Rottb.) Hassk.	H	T	Nt/N	U
Cyperus compressus L.	H	T	Nt/N	U
Cyperus difformis L.	H	A/T	Nt/N	U
Cyperus kyllingia Endl.	H	T,A	Nt/N	U
Cyperus polystachyos Rottb.	H	T,A	Nd	U
Fimbristylis cymosa R. Br.	H	T	Nd	U
Scirpus littoralis var. *capensis* (Boeck.) Koyama	H	A	Nd	U/Cl
Liliaceae (*sensu lato*) (Lily family)				
Hymenocallis littoralis (Jacq.) Salisb.	H	T	Nt/N	C
Sanseviera sp. Tigre; Bowstring Hemp	H	T	Nt/N	U/Cl
Orchidaceae (Orchid family)				
Spathoglottis plicata Bl.	H	T/E	Nd	U
Taeniophylum mariannense Schltr. Kamuke-nanofe; amot-otdon; worm orchid	H	E	Nd	U
Zeuxine fritzii Schltr.	H	T	Nd	U/Cl
Pandanaceae (Pandanus family)				
Pandanus dubius Spreng. Pahong; Screw Pine	T	T	Nd	U
Pandanus tectorius Park. Kafu; Screw Pine	T	T	Nd	C

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Poaceae (Gramineae) (Grass family)				
Cenchrus echinatus L. Bur-grass; Sandspur	H	T	Nt/N	U
Chloris inflata Link Fingergrass	H	T	Nt/N	C
Chrysopogon aciculatus (Retz.) Trin. Inifuk; Palaii	H	T	Nd	U
Cynodon dactylon (L.) Pers. Bermuda Grass	H	T	Nt/N	C
Dactyloctenium aegyptium (L.) Beauv.	H	T	Nt/N	U
Dichanthium blahdii (Retz.) Clayton	H	T	Nt/N	U/Cl
Echinochloa colonum (L.) Link Chaguan-Agaga; Jungle-Rice	H	T/A	Nd	U
Eleusine indica Gaertn. Umog; Goose Grass	H	T	Nt/N	C
Eragrostis ciliaris (L.) R. Br.	H	T	Nt/N	C
Eragrostis amabilis (L.)W. & A. . Lovegrass	H	T	Nt/N	C
Eragrostis sp.	H	T	Nt/N	U
Eustachys petraea (Sw.) Desv.	H	T	Nt/N	U/Cl
Imperata conferta (J.S. Presl) Ohwi	H	T	Nt/N	U
Ischaemum sp.	H	T	Nt	R
Lepturus repens R. Br. Lesaga	H	T	Nd	C
Panicum maximum Jacq. Gunica grass	H	T	Nt/N	C
Panicum muticum Forssk.	H	T	Nt/N	C
Paspalum conjugatum Berg. Hilo grass	H	T	Nt/N	U
Paspalum distichum L. (*P. vaginalis* Sis.) Saltgrass; Knotgrass; Couchgrass	H	T	Nd	R

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Poaceae (Gramineae) (Grass family) (Cont'd)				
Pennisetum purpureum Schumach. Elephant grass				
Sporobolus fertilis (Steud.) Clayton Wiregrass	H	T	Nt/N	C
Thuarea involuta (Forst) R. Br. Ex R. J. S. Las-aga	H	T	Nd	C
Zoysia matrella var. *pacifica* Goudsew. Templegrass	H	T	Nd	C

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Dicotyledons				
Acanthaceae (Acanthus family)				
Blechum brownei Juss. var. *puberulum* Yerbas babui	H	T	Nt/N	U/Cl
Pseuderanthemum carruthersii (Seem.) Guill. var. *carruthersii*	S	T	NT	U
Amaranthaceae (Amaranth family)				
Achyranthes aspera L. Chichitum; Lasogado	H	T	Nt/N	U
Deeringia amaranthoides (Lam.) Merr.	V/S	T	Nd	U/Cl
Araliaceae (Panax family)				
Polyscias fruticosa (L.) Harms Papua	S/T	T	Nd	R
Asteraceae (Compositae) (Daisy family)				
Bidens alba (L.) DC. Daisy	H	T	Nt/N	C
Eupatorium odoratum L.	H	T	Nt/N	C
Mikania scandens (L.) Willd. Mile-a-minute	V	T	Nt/N	C
Pluchea indica (L.) Less.	S	T	Nt/N	C/Cl
Pluchea symphitifolia (Mill.) Gillis	S	T	Nt/N	U/Cl
Pluchea x fosbergii	S	T	Nt/N	R
Vernonia cinerea (L.) Less. Chaguan Santa Maria	H	T	Nt/N	U
Boraginaceae (Heliotrope family)				
Heliotropium procumbens var. *depressum* (Cham.) Fosb. & Sachet Hunig-tasi	H	T	Nt/N	U
Tournefortia argentea L.f. Hunig; Beach Heliotrope	T	T	Nd	U
Caesalpiniaceae (Leguminosae) (Senna family)				
Delonix regia (Bojer) Raf. Royal poinciana; flamboyant	T	T	Nd	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Caricaceae (Papaya family)				
Carica papaya L. Papaya	H,T	T	Nt/N	U
Casuarinaceae (Casuarina family)				
Casuarina equisetifolia L. Gago; Ironwood; Australian Pine	T	T	Nd	C
Convolvulaceae (Morning Glory family)				
Ipomoea indica (Burm.) Merr. Fufgu; asa-gao; Japanese Morning-glory	V	T	Nt/N	C
Ipomoea macrantha R. & S. alaihai; Moon flower	V	T	Nd	C
Ipomoea pes-caprae ssp. *brasiliensis* (L.) v. Ooststr. alalag-tasi; Beach morning-glory	V	T	Nd	C
Ipomoea triloba L. Fofgu-sabana	V	T	Nt/N	C
Operculina ventricosa (Bert.) Peter Alalag; Wood-rose	V	T	Nt/N	U/Cl
Stictocardia tiliaefolia (Desr.) Hall.f. Abubo	V	T	Nt/N	U
Cucurbitaceae (Gourd family)				
Momordica charantia L. Ahgaga; Bitter-mellon	V	T	Nt/N	U
Euphorbiaceae (Spurge Family)				
Acalypha indica L. Hierba del cancer; Island Catnip	H	T	Nt/N	U
Euphorbia cyathophora Murr. Dwarf Poinsetta	H	T	Nt/N	U
Euphorbia hirta L. Golondrina	H	T	Nt/N	U
Melanolepis multiglandulosa (Reinw. Ex Bl.) Reichb. f. & Zoll.	S	T	Nt/N	R
Phyllanthus amarus Schum. Maigo-lalo	H	T	Nt/N	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Euphorbiaceae (Spurge Family) (Cont'd)				
Phyllanthus marianus Muell.-Arg. Gaogao-uchan	H	T	Nt/N	U
Fabaceae (Leguminosae) (Bean family)				
Abrus precatorius L. Kolales halomtano; Coral bean	V	T	Nd	U
Alysicarpus vaginalis (L.) DC.	H	T	Nt/N	U
Crotalaria pallida Ait. Pale Rattlebox	H	T	Nt/N	U
Desmodium triflorum (L.) DC.	H	T	Nt/N	U
Indigofera suffruticosa Mill.	S	T	Nd	U/Cl
Mucuna gigantea (Willd.) DC. Bayogo dikike; Gayetan	V	T	Nd	U/Cl
Sesbania cannabina (Retz.) Pers.	H	T	Nt/N	R
Goodeniacae (Naupaka family)				
Scaevola sericea Vahl. Nanaso; Half-flower	S	T	Nd	U
Hernandiaceae (Hernandia family)				
Hernandia sonora L. Nonag	T	T	Nd	C
Lamiaceae (Labiatae) (Mint family)				
Hyptis sp.	H/S	T	Nd	R/Cl
Lauraceae (Laurel family)				
Cassytha filiformis L. Agasi; Magagas	V	P	Nd	U
Lythraceae (Crape myrtle family)				
Peniphis acidula Forst. Nigas	S	T	Nd	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Malvaceae (Hibiscus family)				
Hibiscus tiliaceus L. Pago; Sea-hibiscus	T	T	Nd	A
Malvastrum coromandelianum (L.) Garcke	H	T	Nt/N	U
Sida rhombifolia L. var. *rhombifolia* Escobilla dalili; Dalili apaka	H	T	Nt/N	U
Thespesia populnea (L.) Sol ex Correa Banalo; Kilulu; Kuluk	S	T	Nd	C/Cl
Mimosaceae (Leguminosae) (Mimosa family)				
Albizia lebbeck (L.) Benth. Trongkon-mames; Mamis; Woman's tongue	T	T	Nt/N	U
Desmanthus virgatus (L.) Willd.	S	T	Nt/N	U
Leucaena leucocephala (Lam.) de Wit Tangantangan	T	T	Nt/N	A
Mimosa pudica L. Sleeping Grass; Sensitive plant	V	T	Nt/N	C
Pithecellobium dulce (Roxb.) Beth. Kamachile	T	T	Mt/N	C
Moraceae (Fig family)				
Ficus prolixa var. *subcordata* Corner Nunu; Taotaomona tree; Strangler Fig	T	T	Nd	R
Ficus tinctoria var. *neo-ebudarum* (Summerh.) Fosb.	T	T	Nd	R
Myrtaceae (Myrtle family)				
Eugenia palumbis Merr. Agatelang	T	T	Nd	R
Oleaceae (Olive family)				
Jasminum marianum DC. Banago	V	T	Nd	C
Onagraceae (Evening primrose family)				
Ludwigia octovalis (Jacq.) Raven Titimo	H	A	Nd	U

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Oxalidaceae (Oxalis Family)				
Oxalis corniculata L. Apsom; Agsom; Yellow wood-sorrel	H	T	Nt/N	U/Cl
Passifloraceae (Passion flower family)				
Passiflora foetida var. *hispida* (DC.) Killip Love-in-a-mist	V	T	Nt/N	U
Passiflora suberosa L.	V	T	Nt/N	U
Polygalaceae (Polygala family)				
Polygala paniculata L.	H	T	Nt/N	U
Polygonaceae (Buckwheat family)				
Portulaca oleracea var. *granulato-stellulata* v. Poelin Botdolagas, Donkulu	H	T	Nd	U/C
Rhamnaceae (Buckthorn family)				
Colubrina asiatica (L.) Brongn. Gasoso	S	T	Nd	U
Rhizophoraceae (Mangrove family)				
Bruguiera gymnorrhiza (L.) Lam. Mangle lahi	T	A	Nd	A
Rubiaceae (Coffee family)				
Aidia cochinchinensis Lour. Sumac	T	T	Nd	U
Dentaria repens J.R. & G. Forst. Borduegas	H	T	Nt/N	U
Hedyotis strigulosa (Bartl. ex DC.) Fosb.	H	T	Nd	U
Morinda citrifolia L. Lada	T	T	Nd	U
Psychotria mariana Bartl. ex. DC.	T	T	Nd	U
Spermacoce assurgens R. & P.	H	T	Nt/N	U
Rutaceae (Rue family)				
Citrus sp.	T	T	Nt	R

Table 1. (Cont'd)

Name	Growth form	Habit	Status	Relative Abundance
Sapindaceae (Soapberry family)				
Allophylus timorensis (DC.) Bl. Nger	S	T	Nd	R
Dodonaea viscosa (L.) Jacq.	T	T	Nt/N	U/Cl
Sapotaceae (Sapodilla family)				
Pouteria obovata (R. Br.) Baehni	T	T	Nd	U
Scrophulariaceae (Snapdragon family)				
Bacopa monnieri (L.) Wettst. Water hyssop	H	A	Nt/N	U
Bacopa procumbens (Mill.) Greenm.	H	T	Nt/N	U
Solanaceae (Tomato family)				
Physalis sp.	H	T	Nt	R
Tiliaceae (Linden family)				
Muntingia calabura L. Manzanita; Panama Cherry	T	T	Nt/N	U
Urticaceae (Nettle family)				
Pilea microphylla (L.) Liebm. Artillery plant	H	T	Nt/N	U
Verbenaceae (Vervain family)				
Lippia nodiflora (L.) Rich.	H	T	Nt/N	U/Cl
Premna obtusifolia R. Br.	T	T	ND	U
Stachytarpheta jamaicensis (L.) Vahl Jamaica Vervain	H	T	Nt/N	C
Stachytarpheta urticifolia Sims Nettle-leaved vervain	H	T	Nt/N	U

Table 2. Importance Values of Dominant Species Along Four Transects

Transect 1. Species and Importance values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined	
1m		1-3m		3-10m		10m			
Nephrolepis hirsutula	0.645	*Leucaena leucocephala*	0.424	*Hibiscus tiliaceus*	0.901	*Leucaena leucocephala*	1.019	*Hibiscus tiliaceus*	1.546
Leucaena leucocephala	0.275	*Hibiscus tiliaceus*	0.383	*Leucaena leucocephala*	0.469	*Hibiscus tiliaceus*	0.391	*Leucaena leucocephala*	0.528
Eupatorium odoratum	0.223	*Ipomoea indica*	0.280	*Ipomoea indica*	0.240	*Ipomoea indica*	0.205	*Ipomoea indica*	0.238
Ipomoea indica	0.222	*Momordica charantia*	0.154	*Passiflora suberosa*	0.133	*Mucuna gigantea*	0.139	*Nephrolepis hirsutula*	0.104
Hibiscus tiliaceus	0.168	*Ipomoea macrantha*	0.149	7 other species, each < 0.100		4 other species, each < 0.100		19 other species, each < 0.100	
Polypodium scolopendria	0.139	*Eupatorium odoratum*	0.130						
Momordica charantia	0.135	*Ficus tinctoria*	0.103						
5 other species, each < 0.100		7 other species, each < 0.100							

Table 2. (Cont'd)

Transect 2. Species and Importance Values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined	
1m		1-3m		3-10m		10m			
Acrostichum aureum	1.011	*Ipomoea indica*	0.475	*Leucaena leucocephala*	1.040	*Casuarina equisetifolia*	1.618	*Acrostichum aureum*	0.488
Mikania scandens	0.503	*Morinda citrifolia*	0.346	*Jasminum marianum*	0.825	*Jasminum marianum*	0.382	*Leucaena leucocephala*	0.242
Ipomoea indica	0.113	*Eupatorium odoratum*	0.247	*Ipomoea macrantha*	0.136	No other species		*Mikania scandens*	0.242
Ipomoea macrantha	0.111	*Mucuna gigantea*	0.228	No other species.				*Jasminum marianum*	0.231
Polypodium scolopendria	0.111	*Ipomoea macrantha*	0.217					*Casuarina equisetifolia*	0.160
2 other species, each 0.100		*Hibiscus tiliaceus*	0.189					*Ipomoea indica*	0.159
		Leucaena leucocephala	0.169					*Ipomoea macrantha*	0.129
		Jasminum marianum	0.130					*Eupatorium odoratum*	0.101
		No other species.						5 other species, each < 0.100	

Table 2. (Cont'd)

Transect 3. Species and Importance Values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined	
1m		1-3m		3-10m		10m			
Acrostichum aureum	0.665	*Pandanus dubius*	0.579	*Hernandia sonora*	0.642	*Thespesia populnea*	0.746	*Hernandia sonora*	0.502
Polypodium scolopendria	0.381	*Hernandia sonora*	0.324	*Pandanus dubius*	0.576	*Mikania scandens*	0.626	*Pandanus dubius*	0.324
Hernandia sonora	0.276	*Polypodium scolopendria*	0.274	*Morinda citrifolia*	0.190	*Hernandia sonora*	0.621	*Thespesia populnea*	0.269
Mikania scandens	0.231	*Ficus tinctoria*	0.230	*Mucuna gigantea*	0.141	*Pithecellobium dulce*	0.228	*Polypodium scolopendria*	0.135
Eupatorium odoratum	0.173	*Leucaena leucocephala*	0.218	*Melanolepis multiglandulosa*	0.115	*Pandanus dubius*	0.217	*Acrostichum aureum*	0.130
Thelypteris opulenta	0.127	*Eupatorium odoratum*	0.106	4 other species, each < 0.100		1 other species < 0.100		*Mucuna gigantea*	0.104
2 other species, each 0.100		3 other species, each 0.100						12 other species, each < 0.100	

Table 2. (Cont'd)

Transect 4. Species and Importance Values

Bottom Stratum		Lower Stratum		Upper Stratum		Top Stratum		All Strata Combined	
1m		1-3m		3-10m		10m			
Acrostichum aureum	0.664	*Pandanus dubius*	0.734	*Pandanus dubius*	1.135	*Casuarina equisetifolia*	1.558	*Bruguiera gymnorrhiza*	0.830
Hymenocallis littoralis	0.491	*Hibiscus tiliaceus*	0.367	*Hibiscus tiliaceus*	0.229	*Hernandia sonora*	0.183	*Pandanus dubius*	0.498
Nephrolepis hirsutula	0.202	*Bruguiera gymnorrhiza*	0.216	*Hernandia sonora*	0.221	*Bruguiera gymnorrhiza*	0.174	*Casuarina equisetifolia*	0.314
Bruguiera gymnorrhiza	0.140	*Hernandia sonora*	0.132	*Bruguiera gymnorrhiza*	0.115	*1* other species, < 0.100		*Acrostichum aureum*	0.181
Pandanus dubius	0.112	*Passiflora suberosa*	0.126	4 other species, each < 0.100				*Hibiscus tiliaceus*	0.147
Polypodium scolopendria	0.107	*Phyllanthus marianus*	0.126					*Hymenocallis littoralis*	0.137
Eupatorium odoratum	0.101	4 other species, each < 0.100						*Hernandia sonora*	0.125
2 other species, each < 0.100								12 other species, each < 0.125	

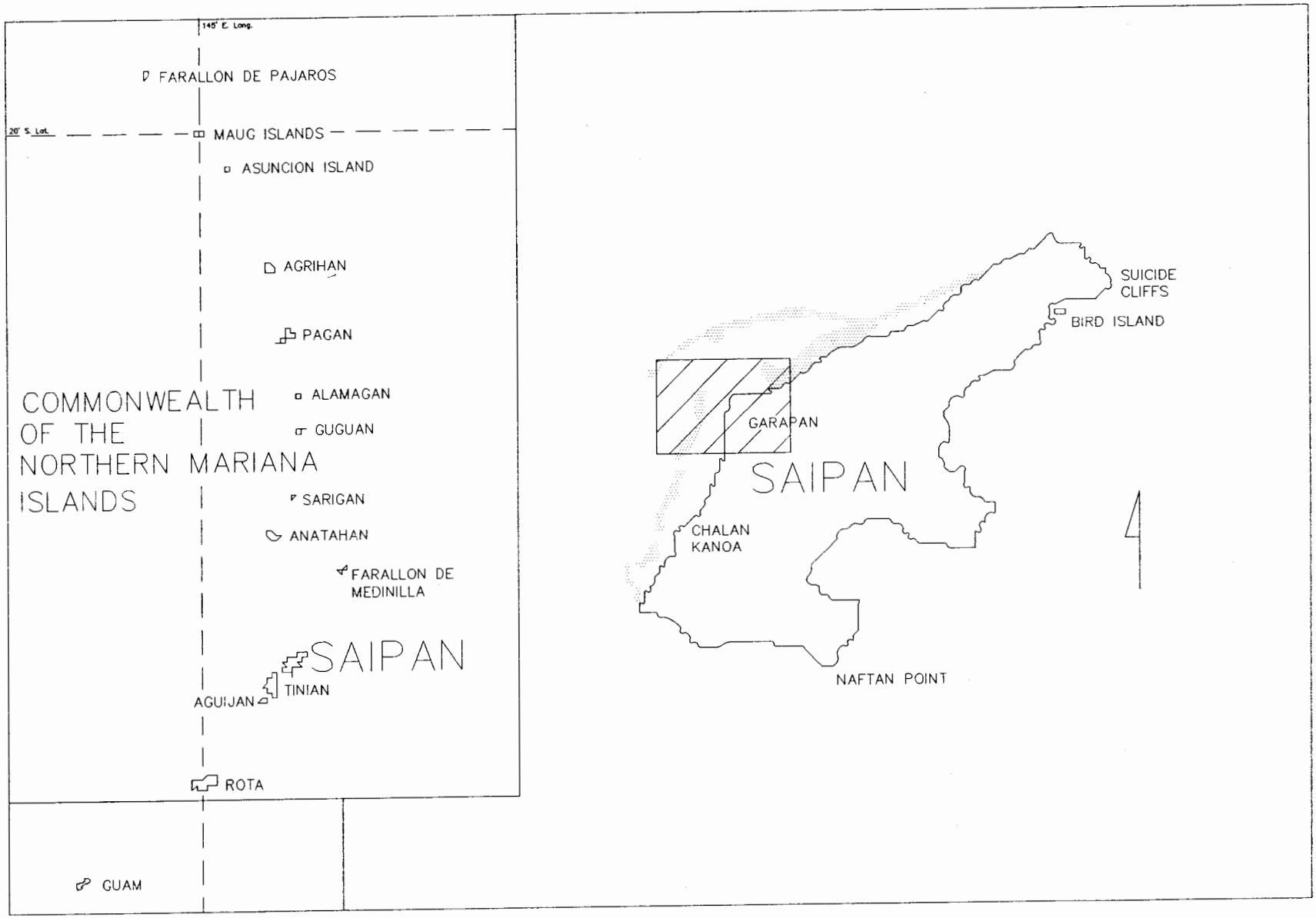

Fig 1. Vicinity Map

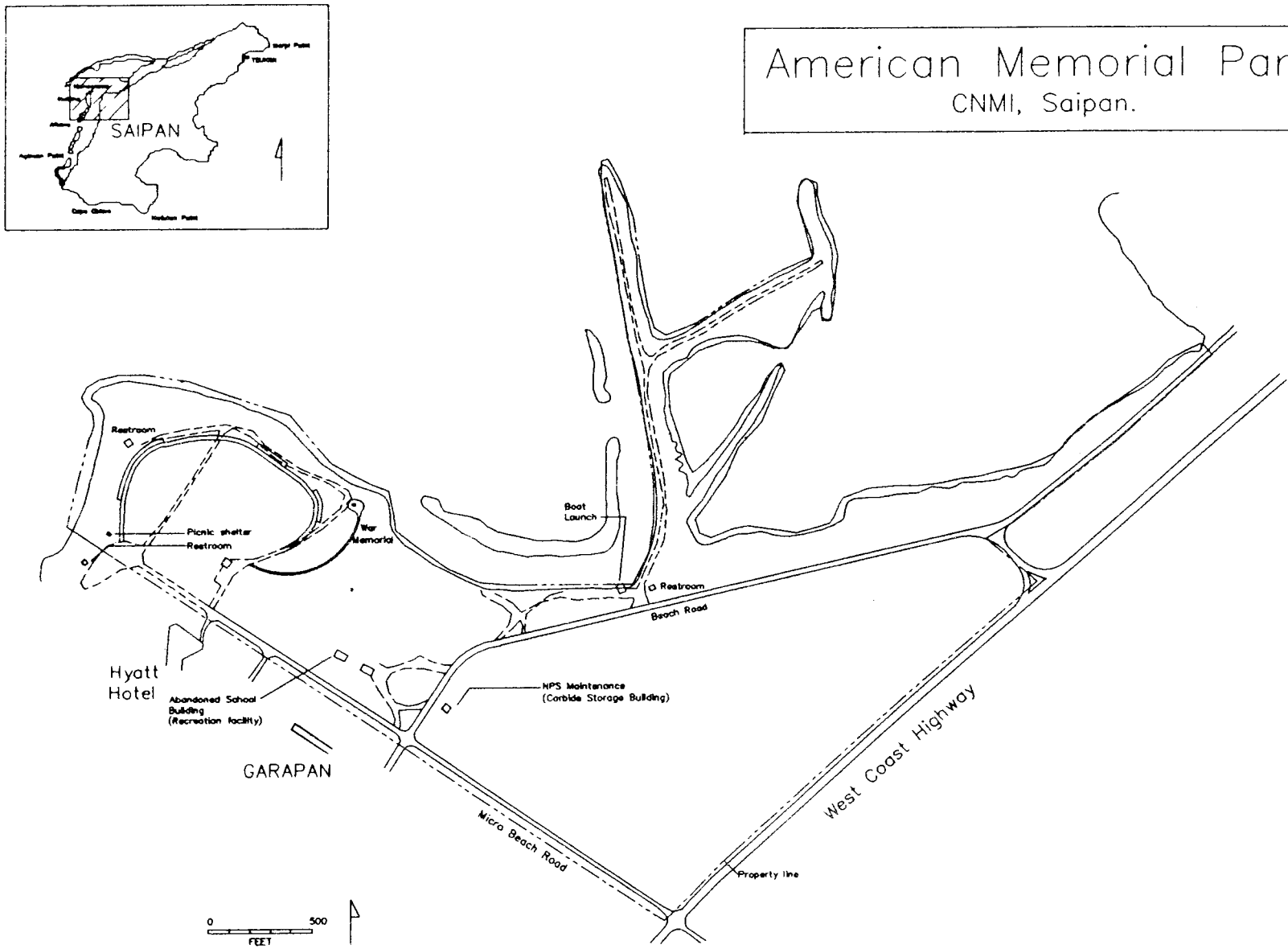

Fig 2. Map of American Memorial Park, Saipan

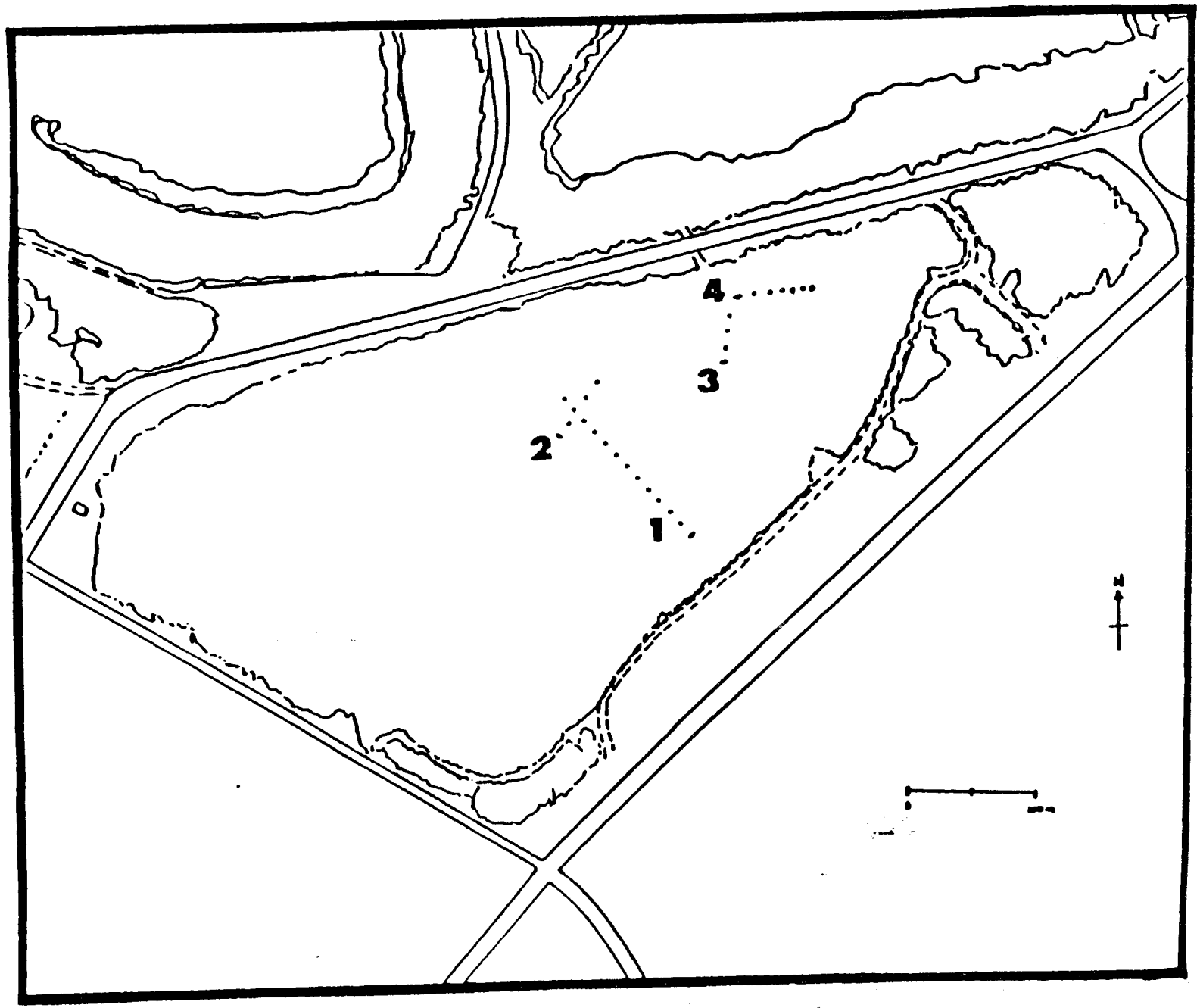

Fig 3. Location of Vegetation transects in American Memorial Park, Saipan

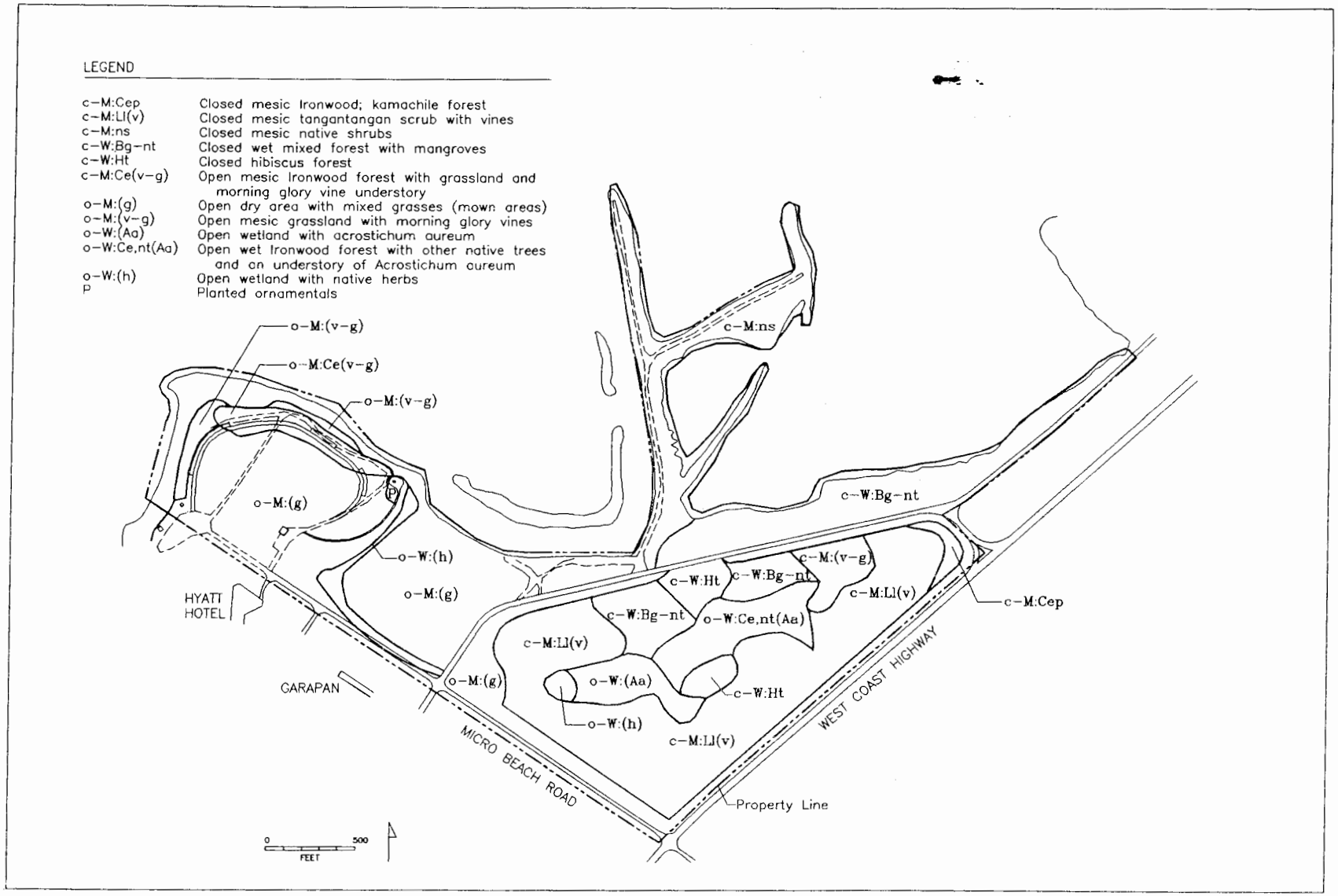

Fig 4. Vegetation Map of American Memorial Park, Saipan

Fig 5. Garapan and the barrier reef with Managaha Island from Mt. Topochau.

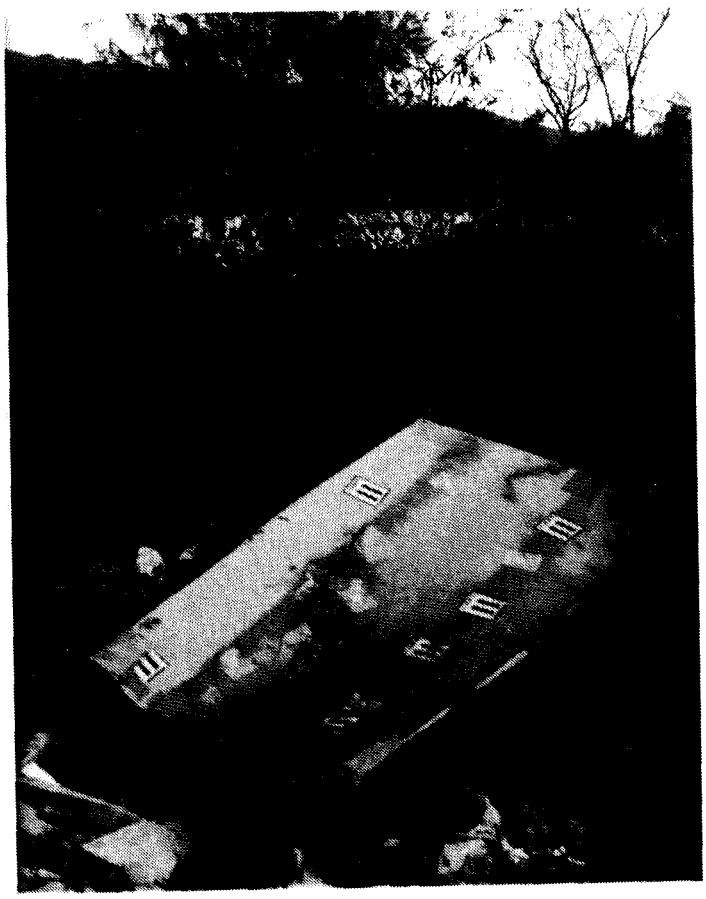

Fig 6. Dumping area.

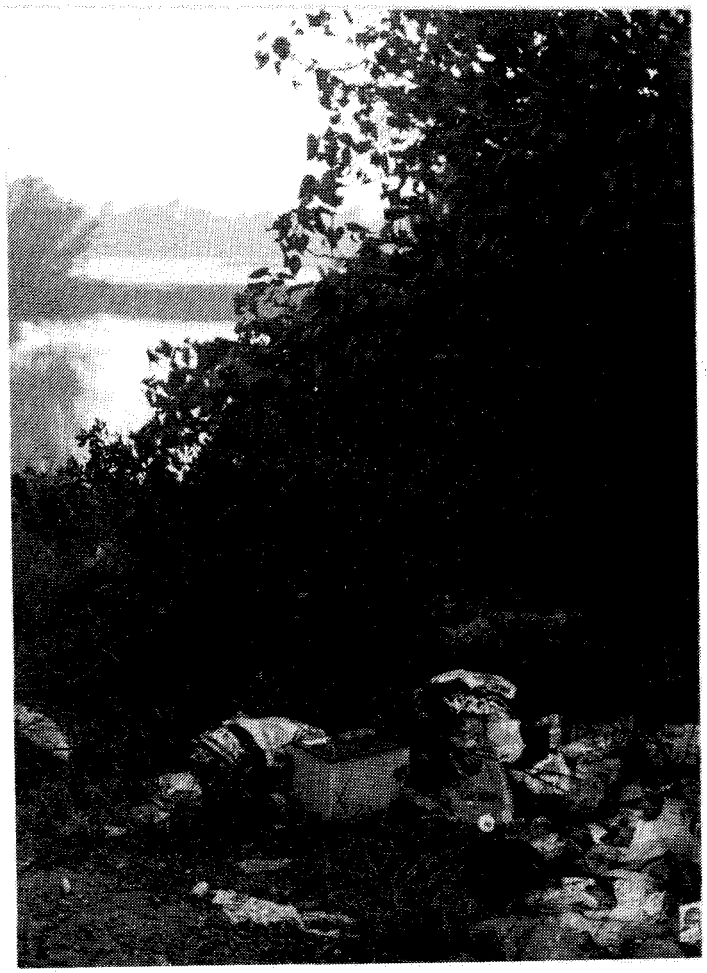

Fig 7. Trash and smoke from the dump.

Fig 8. Trash and smoke from the dump and eroding jetty.

Fig 9. Mangle lahi (*Bruguiera gymnorrhiza*). Only Pacific mangrove on Saipan.

Fig 10. *Scirpus littoralis*.

Fig 11. Hilo grass (*Paspalum distichum*), and Langayao (*Acrostichum aureum*) in the background.

Fig 12. Fufgu (*Ipomoea indica*) growing on tangantangan (*Leucaena leucocephala*).

Fig 13. Mile a minute (*Mikania scandens*) and fufgu (*Ipomoea indica*) growing on tangantangan (*Leucaena leucocephala*).

Fig 14. *Eupatorium odoratum*.

Fig 15. Temple grass (*Zoysia matrella*) on the jetty.

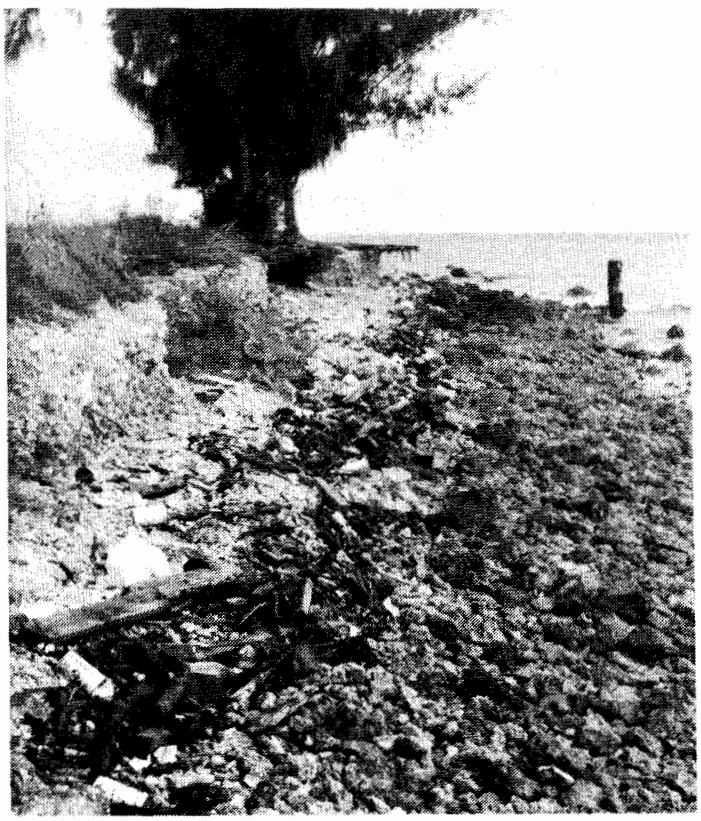

Fig 16. Trash from the municipal dump.

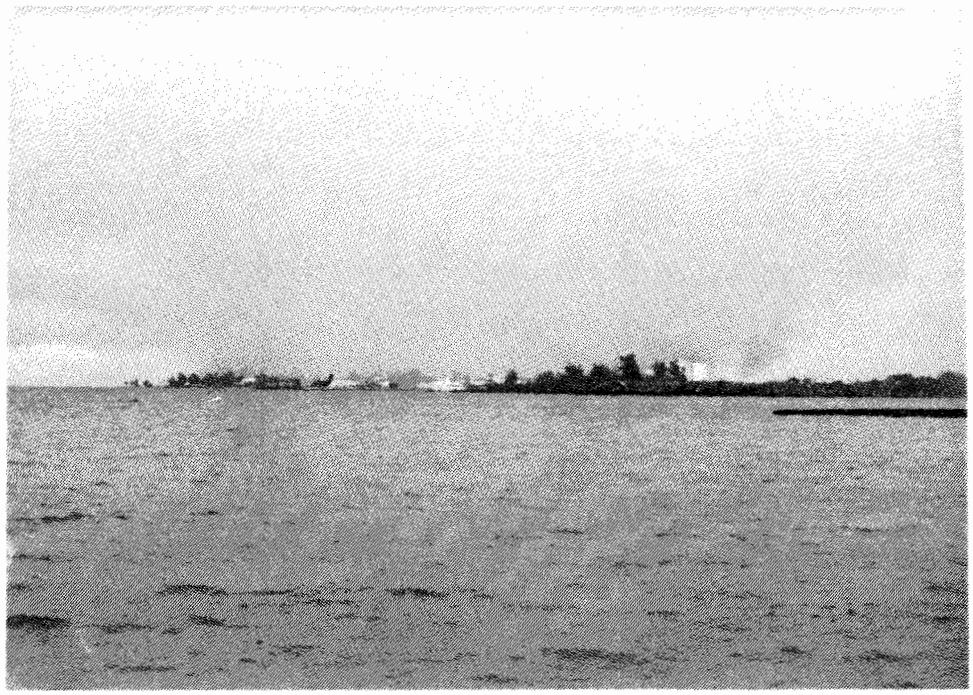

Fig 17. Smoke from the dump.

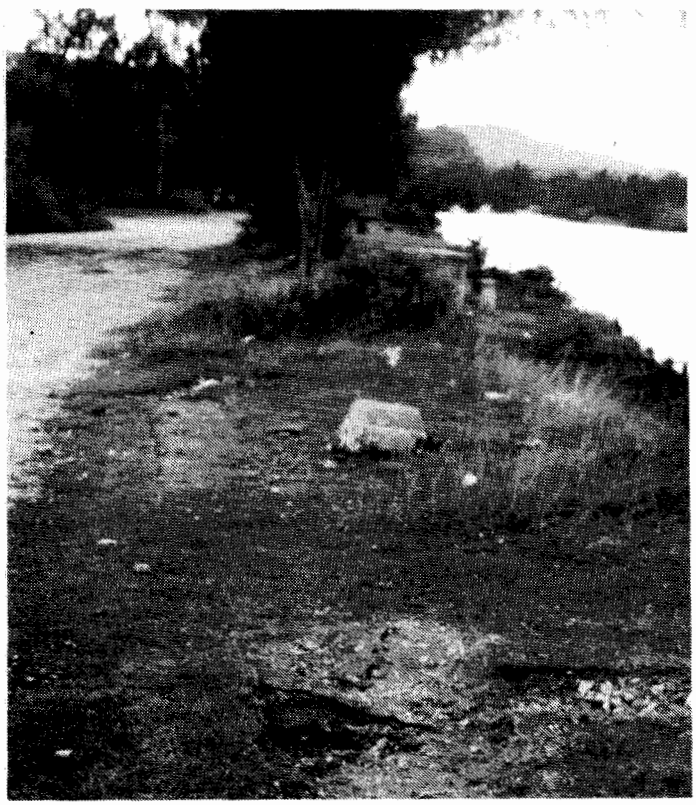

Fig 18. Harvested turf.

Appendix

Raw Data used to calculate Importance Values

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Date : 7 August 1986							
Transect #1 - Totals of all 4 Strata							
Total transect length (L) 600m Total number of transect intervals 120							
Hibiscus tiliaceus	39	0.325	0.209	137.6m	0.229	0.337	1.546
Leucaena leucocephala	42	0.350	0.225	123.7m	0.206	0.303	0.528
Ipomoea indica	27	0.225	0.145	38.1m	0.064	0.093	0.238
Pouteria obovata	3	0.025	0.016	2.6m	0.004	0.006	0.022
Polypodium scolopendria	5	0.042	0.027	7.5m	0.013	0.018	0.045
Momordica charantia	12	0.100	0.064	9.9m	0.017	0.024	0.088
Acalypha indica	1	0.008	0.005	0.2m	0.0003	0.001	0.006
Eupatorium odoratum	8	0.067	0.043	10.4m	0.017	0.026	0.069
Carica papaya	1	0.008	0.005	1.0m	0.002	0.003	0.008
Passiflora suberosa	7	0.058	0.037	11.0m	0.018	0.627	0.064
Desmanthus virgatus	1	0.008	0.005	0.4m	0.001	0.001	0.006
Jasminum marianum	7	0.058	0.037	11.2m	0.019	0.028	0.065
Ficus tinctoria	2	0.017	0.011	4.5m	0.008	0.011	0.022
Transect # 1 Bottom stratum							
Total transect length (L) 150m Total number of transect intervals 30							
Hibiscus tiliaceus	4	0.133	0.103	3.7m	0.025	0.065	0.168
Leucaena leucocephala	4	0.133	0.103	9.8m	0.065	0.172	0.275
Ipomoea indica	5	0.167	0.129	5.3m	0.035	0.093	0.222
Pouteria obovata	1	0.033	0.025	1.2m	0.008	0.021	0.046
Momordica charantia	4	0.133	0.103	1.8m	0.012	0.032	0.135
Polypodium scolopendria	3	0.100	0.077	3.5m	0.023	0.062	0.139
Acalypha indica	1	0.033	0.025	0.2m	0.001	0.004	0.029

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect # 1 Bottom stratum (Cont'd)							
Total transect length (L) 150m Total number of transect intervals 30							
Eupatorium odoratum	6	0.200	0.154	3.9m	0.026	0.069	0.223
Passiflora suberosa	1	0.033	0.025	0.3m	0.002	0.005	0.030
Stictocardia tiliaefolia	1	0.033	0.025	0.2m	0.001	0.004	0.029
Mikania scandens	1	0.033	0.025	2m	0.013	0.035	0.060
Nephrolepis hirsutula	8	0.267	0.206	25m	0.167	0.439	0.645
Totals	f = 1.298	Rf = 1.0	I = 56.9m		IC = 0.603	RC = 1.0	
Transect #1 - Lower stratum							
Total transect length (L) 150m Total number of transect intervals 30							
Hibiscus tiliaceus	7	0.233	0.140	17.5m	0.117	0.243	0.383
Leucaena leucocephala	8	0.267	0.160	19.0m	0.127	0.264	0.424
Ipomoea indica	9	0.300	0.180	7.2m	0.048	0.100	0.280
Pouteria obovata	2	0.067	0.040	1.4m	0.009	0.020	0.060
Polypodium scolopendria	2	0.067	0.040	4.0m	0.027	0.056	0.096
Momordica charantia	5	0.167	0.100	3.9m	0.026	0.054	0.154
Eupatorium odoratum	2	0.067	0.040	6.5m	0.043	0.090	0.130
Passiflora suberosa	1	0.033	0.020	0.3m	0.002	0.004	0.024
Desmanthus virgatus	1	0.033	0.020	0.4m	0.003	0.006	0.026
Jasminum marianum	2	0.067	0.040	3.0m	0.020	0.042	0.082
Ficus tinctoria	2	0.067	0.040	4.5m	0.030	0.063	0.103
Psychotria mariana	2	0.067	0.040	1.7m	0.011	0.024	0.064
Melanolepis multiglandulosa	1	0.033	0.020	0.4m	0.003	0.006	0.026
Ipomoea indica	6	0.200	0.120	2.1m	0.014	0.029	0.149
Totals	f = 1.668	Rf = 1.0	I = 71.9		IC = 0.48	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect # 1 Upper stratum							
Total transect length (L) 150m Total number of transect intervals 30							
Hibiscus tiliaceus	23	0.767	0.354	92.9m	0.619	0.547	0.901
Leucaena leucocephala	15	0.500	0.231	40.4m	0.269	0.238	0.469
Ipomoea indica	10	0.333	0.154	14.6m	0.097	0.086	0.240
Momordica charantica	2	0.067	0.031	0.5m	0.003	0.003	0.034
Carica papaya	1	0.033	0.015	1.0m	0.007	0.006	0.021
Passiflora suberosa	4	0.133	0.061	6.4m	0.043	0.038	0.133
Jasminum marianum	2	0.067	0.031	3.0m	0.020	0.018	0.049
Mucuna gigantea	4	0.133	0.061	4.5m	0.030	0.027	0.088
Mikania scandens	2	0.067	0.031	4.0m	0.027	0.024	0.055
Morinda citrifolia	1	0.033	0.015	2.0m	0.013	0.012	0.027
Pithecellobium dulce	1	0.033	0.015	0.4m	0.003	0.002	0.017
Totals f = 2.166		Rf = 1.0		I = 169.7	IC = 1.131	RC = 1.0	
Transect #1 Top stratum							
Total transect length (L) 150m Total number of transect intervals 30							
Hibiscus tiliaceus	5	0.167	0.167	23.5m	0.157	0.224	0.391
Leucaena leucocephala	15	0.500	0.500	54.5m	0.363	0.519	1.019
Ipomoea indica	3	0.100	0.100	11.0m	0.073	0.105	0.205
Momordica charantia	1	0.033	0.033	4.5m	0.030	0.013	0.076
Passiflora suberosa	1	0.033	0.033	4.0m	0.027	0.038	0.071
Stictocardia tiliaefolia	1	0.033	0.033	3.0m	0.020	0.029	0.062
Mucuna gigantea	3	0.100	0.100	4.0m	0.027	0.039	0.139
Pithecellobium dulce	1	0.033	0.033	0.4m	0.003	0.004	0.037
Totals f = 0.999		Rf = 1.0		I = 105	IC = 0.7	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect # 2 - Total for all strata							
Total transect length (L) 220m Total number of transect intervals 44							
Hibiscus tiliaceus	1	0.023	0.022	2.5m	0.011	0.020	0.042
Acrostichum aureum	9	0.205	0.195	36m	0.164	0.293	0.488
Casuarina equisetifolia	4	0.091	0.087	9m	0.041	0.073	0.160
Mikania scandens	5	0.114	0.109	16.3m	0.074	0.133	0.242
Leucaena leucocephala	6	0.136	0.130	13.8m	0.063	0.112	0.242
Ipomoea indica	3	0.068	0.065	11.5m	0.052	0.094	0.159
Polypodium scolopendria	2	0.046	0.044	0.9m	0.004	0.007	0.051
Jasminum marianum	1	0.023	0.022	3.5m	0.016	0.029	0.051
Passiflora suberosa	1	0.023	0.022	0.8m	0.004	0.007	0.029
Morinda citrifolia	2	0.046	0.044	4.2m	0.019	0.034	0.078
Ipomoea macrantha	5	0.114	0.109	2.4m	0.011	0.020	0.129
Eupatorium odoratum	2	0.046	0.044	7m	0.032	0.057	0.101
Totals	f = 1.049	Rf = 1.0		I = 122.9m	IC = 0.559	RC = 1.0	
Transect #2 - Bottom stratum							
Total transect length (L) 55m Total number of transect intervals 11							
Acrostichum aureum	9	0.818	0.431	36m	0.655	0.58	1.011
Mikania scandens	5	0.455	0.240	16.5m	0.296	0.263	0.503
Ipomoea indica	1	0.091	0.048	4m	0.073	0.065	0.113
Polypodium scolopendria	2	0.182	0.096	0.9m	0.016	0.015	0.111
Passiflora suberosa	1	0.091	0.048	0.8m	0.015	0.013	0.061
Ipomoea macrantha	2	0.182	0.096	0.9m	0.016	0.015	0.111
Eupatorium odoratum	1	0.091	0.048	3m	0.055	0.049	0.097
Totals	f = 1.900	Rf = 1.0		I = 61.9m	IC = 1.126	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #2 - Lower stratum							
Total transect length (L) 55m Total number of transect intervals 11							
Hibiscus tiliaceus	1	0.091	0.091	2.5m	0.046	0.098	0.189
Leucaena leucocephala	1	0.091	0.091	2m	0.036	0.078	0.169
Ipomoea indica	2	0.182	0.182	7.5m	0.136	0.293	0.475
Jasminum marianum	1	0.091	0.091	1m	0.018	0.039	0.130
Mucuna gigantea	1	0.091	0.091	3.5m	0.064	0.137	0.228
Morinda citrifolia	2	0.182	0.182	4.2m	0.076	0.164	0.346
Ipomoea macrantha	2	0.182	0.182	0.9m	0.016	0.035	0.217
Eupatorium odoratum	1	0.091	0.091	4m	0.073	0.156	0.247
Totals	f = 1.001	Rf = 1.0	I = 25.6m		IC = 0.465	RC = 1.0	
Transect #2 - Upper stratum							
Total transect length (L) 55m Total number of transect intervals 11							
Leucaena leucocephala	5	0.455	0.556	11.8m	0.215	0.484	1.04
Jasminum marianum	3	0.273	0.333	12m	0.218	0.492	0.825
Ipomoea macrantha	1	0.091	0.111	0.6m	0.011	0.025	0.136
Totals	f = 0.819	Rf = 1.0	I = 24.4m		IC = 0.444	RC = 1.0	
Transect #2 - Top stratum							
Total transect length (L) 150m Total number of transect intervals 30							
Casuarina equisetifolia	4	0.364	0.800	9m	0.164	0.818	1.618
Jasminum marianum	1	0.091	0.200	2m	0.036	0.182	0.382
Totals	f = 0.455	Rf = 1.0	I = 11m		IC = 0.2	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #3; Totals for all strata							
Total transect length (L) 200m Total number of transect intervals 40							
Acrostichum aureum	3	0.075	0.049	10.8m	0.054	0.081	0.130
Pyrrosia lanceolata	1	0.025	0.016	1.0m	0.005	0.008	0.024
Thespesia populnea	5	0.125	0.082	24.8m	0.124	0.187	0.269
Polypodium scolopendria	6	0.150	0.098	4.9m	0.025	0.037	0.135
Morinda citrifolia	3	0.075	0.049	2.8m	0.014	0.021	0.070
Mikania scandens	2	0.050	0.033	6.5m	0.033	0.049	0.082
Mucuna gigantea	4	0.100	0.066	5.0m	0.025	0.038	0.104
Eupatorium odoratum	3	0.075	0.049	1.5m	0.008	0.011	0.060
Pithecellobium dulce	3	0.075	0.049	2m	0.010	0.015	0.064
Hibiscus tiliacieus	1	0.025	0.016	1m	0.005	0.008	0.024
Ipomoea indica	2	0.050	0.033	0.5m	0.003	0.004	0.037
Pandanus dubius	9	0.225	0.148	23.3m	0.117	0.176	0.324
Ficus tinctoria	2	0.050	0.033	3.5m	0.018	0.026	0.059
Hernandia sonora	12	0.300	0.197	40.5m	0.203	0.308	0.502
Leucaena leucocephala	2	0.050	0.033	1.1m	0.006	0.008	0.041
Passiflora suberosa	1	0.025	0.016	0.1m	0.001	0.001	0.017
Thelypteris opulenta	1	0.025	0.016	1.5m	0.008	0.011	0.027
Melanolepis multiglandulosa	1	0.025	0.016	2m	0.01	0.015	0.031
Totals	f = 1.525		Rf = 1.0	I = 132.8m	IC = 0.669	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #3 - Bottom stratum							
Total transect length (L) 50m Total number of transect intervals 10							
Acrostichum aureum	3	0.333	0.217	10.8m	0.216	0.448	0.665
Polypodium scolopendria	4	0.40	0.261	2.9m	0.058	0.120	0.381
Mikana scandens	1	0.10	0.065	4.0m	0.080	0.166	0.231
Mucunia gigantea	1	0.10	0.065	0.2m	0.004	0.008	0.073
Eupatorium odoratum	2	0.20	0.131	1.0m	0.020	0.042	0.173
Ipomoea indica	1	0.10	0.065	0.2m	0.004	0.008	0.073
Hernandia sonora	2	0.20	0.131	3.5m	0.070	0.145	0.276
Thelypteris opulenta	1	0.10	0.065	1.5m	0.030	0.062	0.127
Totals	f = 1.533		Rf = 1.0	I = 24.1m	IC =		RC = 1.0
Transect #3 Lower stratum							
Total transect length (L) 50m Total number of transect intervals 10							
Polypodium scolopendria	2	0.2	0.150	2m	0.04	0.124	0.274
Morinda citrifolia	1	0.1	0.075	0.2m	0.006	0.019	0.094
Mucuna gigantea	1	0.1	0.075	0.3m	0.006	0.019	0.094
Eupatorium odoratum	1	0.1	0.075	0.5m	0.010	0.031	0.106
Pandanus dubius	3	0.333	0.250	5.3m	0.106	0.329	0.579
Ficus tinctoria	1	0.1	0.075	2.5m	0.050	0.155	0.230
Hernandia sonora	1	0.1	0.075	4m	0.080	0.249	0.324
Leucaena leucocephala	2	0.2	0.150	1.1m	0.022	0.068	0.218
Passiflora suberosa	1	0.1	0.075	0.1m	0.002	0.006	0.081
Totals	f = 1.333		Rf = 1.0	I = 16.1m	IC = 0.375		RC = 1.0

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #3 - Upper stratum							
Total transect length (L) 50m Total number of transect intervals 10							
Pyrrosia lanceolata	1	0.1	0.063	1.0m	0.020	0.026	0.089
Morinda citrifolia	2	0.2	0.125	2.5m	0.050	0.065	0.190
Mucuna gigantea	1	0.1	0.063	3.0m	0.060	0.078	0.141
Hibiscus tiliaceus	1	0.1	0.063	1.0m	0.020	0.026	0.089
Ipomoea indica	1	0.1	0.063	0.3m	0.006	0.008	0.071
Pandanus dubius	4	0.4	0.250	12.5m	0.250	0.326	0.576
Ficus tinctoria	1	0.1	0.063	1m	0.020	0.026	0.089
Hernandia sonora	4	0.4	0.250	15.0m	0.300	0.392	0.642
Melanolepis multiqlandulosa	14	0.1	0.063	2m	0.040	0.052	0.115
Totals f = 1.60		Rf = 1.0		I = 38.3m	IC = 0.766	RC = 1.0	
Transect #3 - Top stratum							
Total transect length (L) 50m Total number of transect intervals 10							
Thespesia populnea	5	0.5	0.289	24.8m	0.496	0.457	0.746
Mikania scandens	1	0.1	0.058	2.5m	0.050	0.046	0.626
Mucuna gigantea	1	0.1	0.058	1.5m	0.030	0.028	0.086
Pithecellobium dulce	3	0.33	0.191	2.0m	0.040	0.037	0.228
Pandanus dubius	2	0.2	0.116	5.5m	0.110	0.101	0.217
Hernandia sonora	5	0.5	0.289	18.0m	0.360	0.330	0.621
Totals f = 1.73		Rf = 1.0		I = 54.3m	IC = 1.086	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #4; total all 4 strata							
Total transect length (L) 240m Total number of transect intervals 48							
Carica papaya	3	0.063	0.038	3.3m	0.014	0.017	0.055
Imperata conferta	2	0.042	0.025	0.8m	0.003	0.004	0.029
Phyllanthus marianus	2	0.042	0.025	1.4m	0.006	0.007	0.032
Hernandia sonora	4	0.083	0.050	15m	0.063	0.075	0.125
Polypodium scolopendria	3	0.063	0.038	2.2m	0.009	0.011	0.049
Leucaena leucocephala	2	0.042	0.025	1.3m	0.005	0.007	0.032
Casuarina equisetifolia	9	0188	0.113	40m	0.167	0.201	0.314
Pandanus dubius	16	0.333	0.199	59.5	0.248	0.299	0.498
Mucuna gigantea	4	0.083	0.050	4.1m	0.017	0.021	0.071
Hymenocallis littoralis	6	0.125	0.075	12.3m	0.051	0.062	0.137
Acrostichum aureum	7	0.146	0.087	18.7m	0.078	0.094	0.181
Morinda citrifolia	1	0.021	0.013	0.5m	0.002	0.003	0.016
Mikania scandens	2	0.042	0.025	0.9m	0.004	0.005	0.030
Eupatorium odoratum	1	0.021	0.013	3m	0.013	0.015	0.028
Hibiscus tiliaceus	6	0.125	0.075	14.4m	0.060	0.072	0.147
Bruguieria gymnorrhiza	6	0.125	0.75	16m	0.067	0.080	0.830
Nephrolepis hirsutula	3	0.063	0.038	4.1m	0.017	0.021	0.059
Pyrrosia lanceolata	1	0.021	0.013	0.4m	0.002	0.002	0.015
Passiflora suberosa	2	0.042	0.025	1.4m	0.006	0.007	0.032
Totals	f = 1.670		Rf = 1.0	I = 199.3m		RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #4 Swamp, swamp forest & associates; bottom (0-1m) stratum							
Total transect length (L) 60m Total number of transect intervals 12							
Imperata conferta	2	0.167	0.077	0.8m	0.01	0.017	0.094
Polypodium scolopendria	2	0.167	0.077	1.4m	0.02	0.030	0.107
Mucuna gigantea	1	0.083	0.038	0.6m	0.01	0.017	0.055
Hymenocallis littoralis	6	0.5	0.231	12.3m	0.205	0.260	0.491
Acrostichum aureum	7	0.583	0.269	18.7m	0.312	0.395	0.664
Eupatorium odoratum	1	0.083	0.038	3m	0.05	0.063	0.1401
Bruguiera gymnorrhiza	2	0.167	0.077	3m	0.05	0.063	0.140
Nephrolepis hirsutula	3	0.25	0.115	4.1m	0.068	0.087	0.202
Pandanus dubius	1	0.083	0.038	3.5m	0.058	0.074	0.112
Totals	f = 2.166	Rf = 1.0		I = 47.4m	IC = 0.783	RC = 1.0	
Transect #4; Lower stratrum							
Total transect length (L) 60m Total number of transect intervals 12							
Carica papaya	2	0.167	0.091	1.3m	0.022	0.032	0.123
Phyllanthus marianus	2	0.167	0.091	1.4m	0.023	0.035	0.126
Hernandia sonora	1	0.083	0.045	3.5m	0.058	0.087	0.132
Leucaena leucocephala	1	0.083	0.045	0.3m	0.005	0.008	0.053
Pandanus dubius	6	0.5	0.273	18.5m	0.308	0.461	0.734
Morinda citrifolia	1	0.083	0.045	0.5m	0.008	0.012	0.057
Mikania scandens	1	0.083	0.045	0.8m	0.013	0.020	0.065
Hibiscus tiliaceus	4	0.333	0.182	7.4m	0.123	0.185	0.367
Brugueria gymnorrhiza	2	0.167	0.091	5m	0.083	0.125	0.216
Passiflora suberosa	2	0.167	0.091	1.4m	0.023	0.035	0.126
Totals	f = 1.833	Rf = 1.0		I = 40.1m	IC = 0.666	RC = 1.0	

Appendix (Cont'd)

Species (i)	Present in how many transect Intervals? (Ji)*	Frequency (fi)	Relative frequency (Rfi)	Intercept length (Ii)*	Linear coverage Index (ICi)	Relative coverage (RCi)	Importance value (IVi)
Transect #4 Upper stratum							
Total transect length (L) 60m Total number of transect intervals 12							
Carica papaya	1	0.083	0.055	2m	0.033	0.034	0.089
Hernandia sonora	2	0.167	0.111	6.5m	0.108	0.110	0.221
Polypodium scolopendria	1	0.083	0.055	0.8m	0.013	0.014	0.069
Leucaena leucocephala	1	0.083	0.055	1m	0.017	0.017	0.072
Pandanus dubius	9	0.750	0.500	37.5m	0.625	0.635	1.135
Mucuna gigantea	1	0.083	0.055	0.8m	0.013	0.014	0.069
Hibiscus tiliaceus	2	0.167	0.111	7m	0.117	0.118	0.229
Bruguiera gymnorrhiza	1	0.083	0.055	3.5	0.058	0.606	0.115
Totals	f = 1.499	Rf = 1.0	I = 59.1m		IC = 0.984	RC = 1.0	
Transect #4 - Top stratum							
Total transect length (L) 60m Total number of transect intervals 12							
Hernandia sonora	1	0.083	0.083	5m	0.083	0.100	0.183
Casuarina equisetifolia	9	0.75	0.751	40m	0.667	0.807	1.558
Mikania scandens	1	0.083	0.083	0.1m	0.002	0.002	0.085
Bruguiera gymnorrhiza	1	0.083	0.083	4.5m	0.075	0.091	0.174
Totals	f = 0.999	Rf = 1.0	I = 49.6m		IC = 0.827	RC = 1.0	